REMARKS

The abstract and specification have been amended in order to correct grammatical and idiomatic errors contained therein. No new matter has been added.

In order to expedite the prosecution of the present application, Claim 1 has been canceled and replaced by newly presented Claim 17 which more particularly points out and distinctly claims the subject matter which Applicants regard as the invention. Claims 2-9 have been amended to reflect the replacement of Claim 1 by Claim 17 and correct possible formal defects contained therein. No new matter has been added.

Claims 1-5 have been rejected under 35 USC 103(a) as being unpatentable over Uhlmann et al in view of Franks. Applicants respectfully traverse this ground of rejection and urge reconsideration in light of the following comments.

The presently claimed invention is directed to a method of manufacturing lamellar U-shaped heat-exchanger tubes which comprises the steps of producing a drawn heat-exchanger tube material made of a nonferrous metal, coiling the drawn heat-exchanger tube material around a storage device, uncoiling the drawn heat-exchanger tube material from the storage device, straightening the drawn heat-exchanger tube material, cutting the drawn heat-exchanger tube material to form tube portions of a desired length either before or after annealing and subsequently cooling the drawn heat-exchanger tube material and bending the tube portions into a U-shape to form the lamellar U-shaped heat-exchanger tubes.

In the manufacture of conventional lamellar U-shaped heat-exchanger tubes, thin-wall tubes are generally obtained in coil form which are uncoiled by the heat-exchanger manufacturer, cut to a desired length and bent to form U-shaped tubes. During the uncoiling process, the tubes are alternately accelerated and braked which makes the thin-wall tubes susceptible to buckling. Since the tubes are generally semi-finished products which are manufactured by a semi-

finishing industry and delivered to an apparatus manufacturer which are often far apart geographically, the coil tubes are generally tightly wound in order to reduce the amount of transport volume needed.

The tight winding of the tube coils creates problems in the handling of the material in that once the tube coils are removed from their transport containers, bend-straightening operations, carried out under longitudinal tensile stresses, to return the tube to a straight condition result in a reduction in its average outside diameter and a reduction in wall thickness in the outer expansion region, an increase in wall thickness in the inner compression region and a flattening and ovalization of its cross-section. Moreover, softening and recrystallization which occur during the bright-annealing of the highly hardened heat-exchanger tubes, which are in the form of tightly wound coils, lead to an adaptation of the tube cross-sections to the geometrically constrained conditions of the coil and, therefore, to changes in the shape of the tube cross-section and in the layer diameters of individual turns. The present invention has been arrived at in order to overcome these problems.

The present invention is based on the discovery that a tube-drawing operation should be immediately followed by an economical method for the production of hairpin tubes. For this purpose, expenditures in the transport and handling of the coiled and relatively sensitive semi-finished production process should be kept as low as possible. The advantages of the present invention reside in the fact that the otherwise usual winding of the hardened heat exchanger tubes to form multi-layered narrow-radius coils that are limited in weight and the stack-wise annealing of those coils in a bright-annealing furnace are circumvented so that the disadvantages of tightly wound tubes such as changes in cross-sectional shape in the form of ovalization, wall thickness changes, and homogeneous stress distribution and a large amount of waste lengths, are also removed. It is respectfully submitted that

the prior art cited by the Examiner does not disclose the presently claimed invention.

The Uhlmann et al reference discloses the processing of copper tubing in which several lengths of tubing are interconnected either in advance by welding or brazing, or on-line by hollow plugs, and fed through an annealing furnace, a jacketing station and a cutter. A flushing gas such as air, oxygen-enriched air or an inert gas are sucked through the respective trailing end. The on-line, end-to-end connection can be used for tubings as prepared in advance and permits continuous processing, particularly, combining process annealing with the removal of oil residues.

The Uhlmann et al reference has been cited by the Examiner as disclosing the uncoiling of the drawn tube material from a storage device, straightening the drawn tube material, annealing and subsequently cooling the drawn tube material before or after cutting, for separation into two portions, to the starting length, but does not disclose the bending of the tube portions into a U-shape. This reference is also said to disclose the further limitations required by Claims 2-5. However, in the Uhlmann et al reference, the tubing is jacketed in a synthetic envelope and used in underfloor heating and wall heating systems or for plumbing applications. The process requires a heating step at a temperature well above an evaporation temperature of an oil which is used in the process, which is a residual deposit inside the tubing. The Uhlmann et al reference is concerned with a cleaning process wherein the resulting oil vapor is continuously removed through an unconnected end of the tubing. Therefore, the disclosure of Uhlmann has nothing to do with the presently claimed process for producing lamellar heat-exchanger tubes.

The Franks et al reference is directed to a method of cutting an elongated tube and apparatus therefore. A cutting device contains an annular cutting member with a radially inner cutting edge through which an elongated, tubular element

is slidably received during the advancement thereof. Actuating means effects movement of the cutting member in an eccentric path around the tubular element so that the cutting operation is performed, after which the severed portion of the tube is bent and ejected from the machine. This reference has been cited as disclosing the bending of the tube portions into a U-shape. However, the Franks reference does not disclose the advantages associated with the presently claimed invention in which the drawn heat-exchanger tube material is subjected to an annealing and cooling step before being bent into a U-shape to therefore avoid the problems associated with the transport of a hardened tubing as discussed above. That is, avoiding the problems associated with the usual winding of the hardened heat-exchanger tubes to form multi-layered narrow-radius coils that are limited in weight, changed in cross-sectional shape in the form of ovalization, wall thickness changes and homogeneous stress distribution and a large amount of waste lengths.

The advantages associated with the presently claimed invention clearly are unexpected in light of the disclosure of the prior art cited by the Examiner and establish the patentability of the presently claimed invention thereover. The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,

TFC/smd

Terryence F. Chapman

FLYNN, THIEL, BOUTELL & TANIS, P.C.
2026 Rambling Road
Kalamazoo, MI 49008-1631
Phone: (269) 381-1156
Fax: (269) 381-5465

David G. Boutell Reg. No. 25 072
Terryence F. Chapman Reg. No. 32 549
Mark L. Maki Reg. No. 36 589
Liane L. Churney Reg. No. 40 694
Brian R. Tumm Reg. No. 36 328
Heon Jekal Reg. No. 64 219
Eugene J. Rath III Reg. No. 42 094
Dale H. Thiel Reg. No. 24 323
Sidney B. Williams, Jr. Reg. No. 24 949

Encl: Replacement Abstract
Clean Substitute Specification
Marked-Up Substitute Specification
Postal Card